Fisheries and Oceans Canada | Pêches et Océans Canada
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Canadian Science Advisory Secretariat
Science Response 2016/028

Maritimes Region

2015 STOCK STATUS UPDATE FOR SCALLOP (*PLACOPECTEN MAGELLANICUS*) IN SCALLOP FISHING AREA 29 WEST OF LONGITUDE OF 65°30'

Context

Advice on the status of Scallops in Scallop Fishing Area 29 West of Longitude of 65°30' is requested annually by Fisheries and Aquaculture Management (FAM) to help determine a Total Allowable Catch (TAC) in support of the fishery. The objectives of this Science Response are to:

1. provide an update on the status of Scallop Fishing Area (SFA) 29 west of 65°30' (referred to as SFA 29 West) scallop stocks by subarea as of the end of 2015;
2. evaluate bycatch of lobster during the 2015 fishery. Identify all information on fishery bycatch of non-target species that may be available and, if available, identify any notable changes in occurrence of bycatch species relative to previous years; and,
3. evaluate the consequences of different harvest levels by subarea during the 2016 fishery on stock abundance and exploitation rate.

The most recent framework and peer-reviewed stock assessment for this stock occurred in 2014 and 2015, respectively (DFO 2015).

This Science Response Report results from the Science Response Process of April 7, 2016, on the Stock Status Update of Scallop in Scallop Fishing Area (SFA) 29 West of 65°30'.

Background

Population surveys have been conducted annually in SFA 29 West by Fisheries and Oceans Canada (DFO) Science since 2001. The survey occurs in September/October after the fishery has closed. The current survey design uses the scallop habitat suitability map developed by Brown et al. (2012) and bins habitat suitability probabilities into three categories defined by the following ranges: Low [0, 0.3), Medium [0.3, 0.6), and High [0.6, 1.0]. Habitat suitability probabilities range from 0 to 1 and represent a relative scale of suitable scallop habitat, with the lowest suitable scallop habitat indicated by 0 and the highest suitable habitat indicated by 1. The population dynamics of commercial and recruit scallops are modelled using the state-space habitat-based assessment model as defined by Smith et al. (2015). In this document, scallops with a shell height of 100 mm and greater (+) are referred to as commercial size. Scallops with a shell height of 90–99 mm are referred to as recruits and are expected to grow to be commercial size in the following year, and scallops with shell height less than (<) 90 mm are considered pre-recruits.

The model was fit within each habitat suitability category for each subarea (A to D) (Smith et al. 2015). Subarea E has not been consistently covered in the survey due to time limitations; much of this subarea is considered to be of marginal habitat for scallops and, as a result, has been less of a survey priority. Subarea E is also not covered by the habitat suitability map.

Scallop removals accounted for in this update include all commercial landings from SFA 29 West and Food, Social, and Ceremonial (FSC) catch by scallop drag. Landed recreational and FSC catch by dip netting, diving, tongs, and hand are not available and not accounted for in the assessment. The last full assessment of SFA 29 West occurred in 2015 (DFO 2015, Sameoto et al. 2015).

Description of the Fishery

Scallop Fishing Area 29 encompasses a very large area inside the 12-mile territorial sea, from the south of Yarmouth (latitude 43°40'N) to Cape North in Cape Breton (Appendix 1). This report refers to only that portion of SFA 29 West of longitude 65°30'W continuing north to Scallop Production Area 3 at latitude 43°40'N. This area is fished by the Full Bay (FB) Fleet and inshore East of Baccaro (EoB) licence holders who are authorized to fish in SFA 29 West (hereafter referred to as the EoB Fleet). The SFA 29 West fishery has occurred since 2001.

Analysis and Response

Commercial Fishery

Starting in 2002, the TAC (meat weight) was shared between the FB and EoB fleets. As of 2010, the TAC and landings are reported as totals by subarea for both fleets combined. In 2015, a total of 84.2 tonnes of meats (t) were landed against the TAC of 87 t. There was an additional Food, Social and Ceremonial (FSC) catch of 6.2 t (Figure 1).

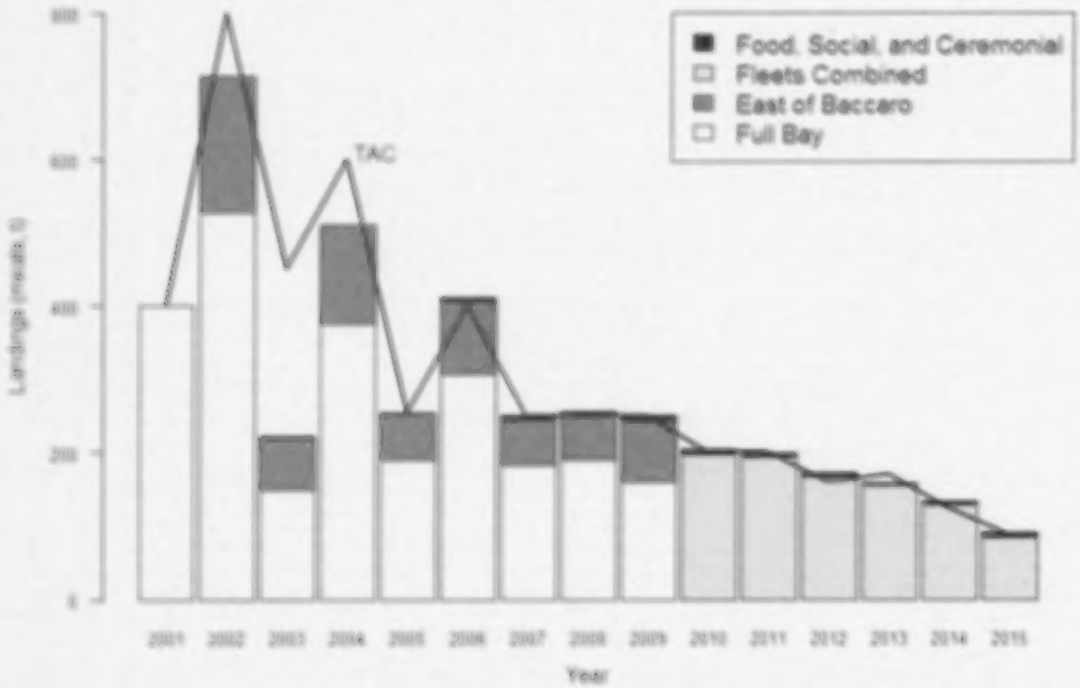

Figure 1. Annual scallop landings (meats, t) from 2001 to 2015 by fleet, which count against the total allowable catch (TAC); landings for FSC purposes, which do not count against the TAC; and total TAC for SFA 29 West.

The scallop fishery in SFA 29 West in 2015 occurred in subareas B, C, D, and E (Appendix 1). Subarea A was closed to fishing in 2015 because a biomass decline was projected for this subarea even with no fishing (Sameoto et al. 2015). There was also a partial closure of subarea D, east of longitude 65°36'0" to protect high abundances of pre-recruit scallops observed in the 2014 survey. Subareas B through E opened for the 2015 fishing season on June 22nd and closed August 31st. Lobster bycatch has not resulted in any closures since 2009.

Catch rates in subarea B increased for the FB Fleet, from 24 kg/h in 2014 to 28 kg/h in 2015. The EoB Fleet fished in subarea B in the 2015 fishing year, but there were not enough records to present these data consistent with *Privacy Act* considerations. There was no fishing in subareas C or D in 2014. Catch rates in subarea C in 2015 were similar to 2013 for the FB Fleet (19 kg/h), and decreased from 2013 for the EoB Fleet (25 kg/h in 2013 and 19 kg/h for 2015). Catch rates in subarea D decreased for both fleets, from 34 kg/h in 2013 to 26 kg/h for FB, and 29 kg/h in 2013 to 25 kg/h for the EoB Fleet. In subarea E, catch rates remained unchanged from 2014 for the FB Fleet (22 kg/h), and decreased from 2014 for the EoB Fleet (23 kg/h in 2014 to 20 kg/h in 2015).

Research Survey

Abundance of commercial sized scallops in SFA 29 West remained relatively low and patchy in 2015, with the majority of tows with < 100 scallops/tow (Figure 2). In subarea A, the number of commercial sized scallops increased from 2014 in the Medium habitat category and remained relatively similar in the Low. In subarea B, increases in the abundance of commercial sized scallops were observed across all habitat categories. In subarea C, there were increases in the abundance of commercial sized scallops in 2015 in the High and Medium habitat categories, whereas abundance in the Low habitat category remained similar to 2014. In subarea D, there were increases in the number of commercial scallops across all habitat suitability classes. However, there was high variability in the commercial numbers per tow in the Low habitat category of subarea D in 2015. For commercial numbers per tow, the average variance from 2001 to 2014 was 152.7 (maximum was 528.5), whereas the variance in 2015 was 6486.0.

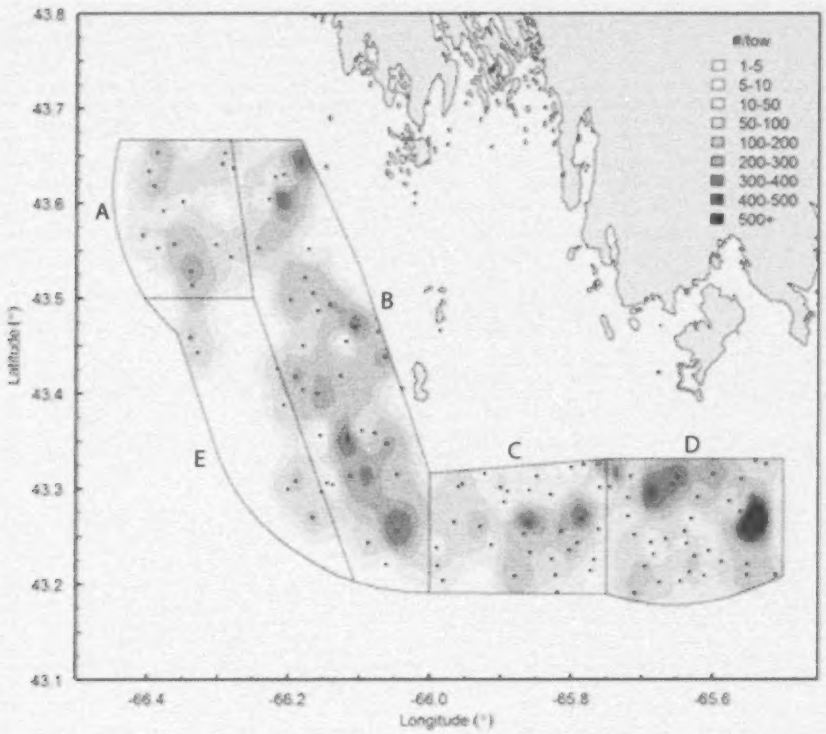

Figure 2. Spatial density (numbers/tow) distribution of commercial scallops (≥ 100 mm shell height) from the 2015 survey for SFA 29 West. Points represent tow locations.

In 2015, recruit abundance (Figure 3) increased throughout subareas B, C, and D and is less patchy than observed in 2014. In subarea A, recruit abundances are relatively unchanged from 2014. In both subareas B and C, there were increases in the abundance of recruit scallops in the High and Medium habitat categories and little change in the Low category. In subarea D, recruit abundance increased in all habitat categories. In 2015, there were 14 tows in the High habitat category of subarea D. One of these tows had high numbers of recruit size scallop (3634/tow) and it is this single tow that is driving the large dark green contour in the eastern closure area of subarea D in Figure 3. This large tow, containing 3634 recruits, disproportionately influences the resultant recruit mean number for the High habitat category in subarea D; the mean including this tow results in the highest recruit numbers in the time series at 280/tow; however, taking the median including this tow results in 22.1/tow. Similar to commercial numbers in the Low habitat category of subarea D, there was also high variability in the recruit numbers per tow in the Low habitat category in D in 2015. From 2001 to 2014, the average variance for recruit numbers per tow was 16.9 (maximum was 61.9), whereas the variance in 2015 was 763.7.

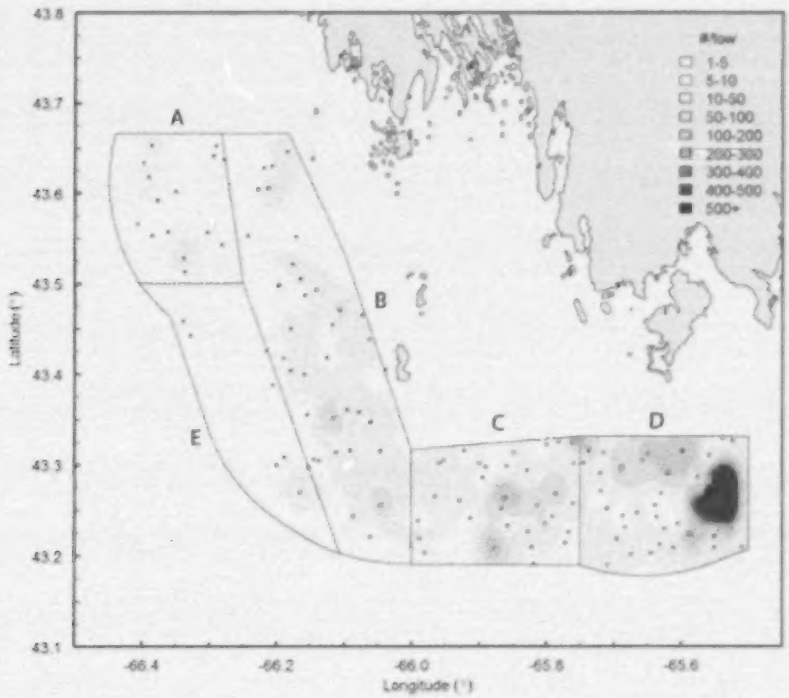

Figure 3. Spatial density (numbers/tow) distribution of recruit scallops (90-99 mm shell height) from the 2015 survey for SFA 29 West. Points represent tow locations.

Pre-recruit abundances in 2015 are highest in the eastern portion of subarea C and throughout subarea D (Figure 4). In subarea A, pre-recruit abundances in 2015 were relatively unchanged from 2014. There was a small increase in pre-recruit abundance in the High habitat category in subarea B, with the other habitats having similar abundances to 2014. In subarea C, there were increases in pre-recruit abundance across all habitat categories. In subarea D, pre-recruit abundances decreased in the Medium and High categories: however, pre-recruit abundances are still relatively high compared to the time series (2001 to 2014).

Prior to 2012, subarea E had not been surveyed since 2005 as it was considered a more marginal area and less of a survey priority. Since 2012, a small number of stations (5-8 per year) have been conducted in this subarea as part of the annual survey. Since 2014, the tows have been allocated within a portion of subarea E known to have been historically fished. Therefore, trends in survey abundance in subarea E may not be indicative of trends in the subarea as a whole. Commercial numbers in 2015 were similar to 2014 (93/tow and 91/tow for 2014 and 2015, respectively); however, recruitment remains low and similar to 2014 (5/tow and 8/tow for 2014 and 2015, respectively). There was an increase in pre-recruits from 2014; however, this is mainly being driven by 2 tows with higher abundances of small pre-recruits (< 35 mm shell height).

Condition has only been calculated for subarea E in 2014 and 2015. In 2014, condition in subarea E was 10.2 g and remained similar in 2015 at 10.5 g. Throughout most of SFA 29 West, condition was between 10-11 g at the time of the survey.

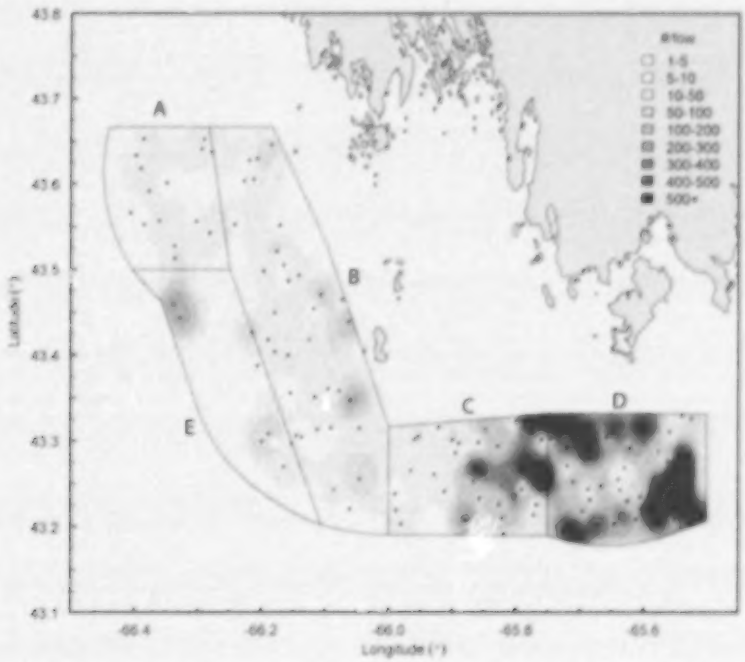

Figure 4. Spatial density (numbers/tow) distribution of pre-recruit scallops (< 90 mm shell height) from the 2015 survey for SFA 29 West. Points represent tow locations.

Assessment Model

The habitat-based population model accepted at the framework assessment in February 2014 (Smith et al. 2015) was used for subareas A–D. The state-space habitat-based population model was fit to the commercial catch, effort derived from vessel monitoring system data, and survey data. For the recruit numbers in the High habitat category in subarea D in 2015, the median value was used in the model. Due to the high variability in commercial and recruit numbers in the Low habitat category in subarea D in 2015, their effects were down-weighted in the model.

Model Exploitation

Exploitation from the model shows low levels of exploitation in all subareas (Figure 5). Exploitation in subarea B decreased from 2014, and was higher in the Medium habitat (0.02) than the High habitat (0.01). Exploitation was the same in the High and Medium habitat in subarea C at 0.04. In subarea D, exploitation in the High habitat was 0.09, and in the Medium exploitation was 0.08.

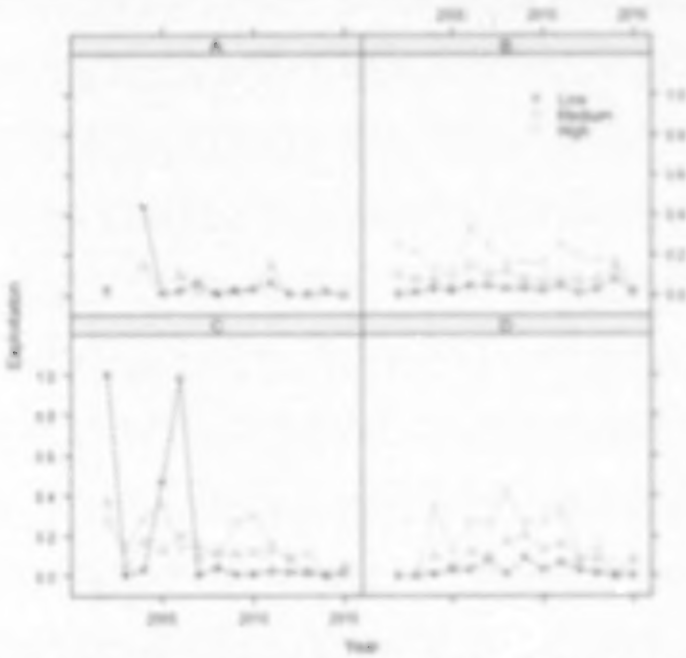

Figure 5. Model estimate of exploitation by Low [0, 0.3), Medium [0.3, 0.6) and High [0.6, 1.0) categories of habitat suitability probabilities in SFA 29 West from 2001 to 2015.

Stock Status

Commercial biomass in the High habitat category was used as an indicator of the overall stock status in subareas B, C, and D. Biomass in the Medium habitat category was used as an indicator in subarea A, since the area of High habitat category in subarea A is very small (< 1%). Catch, exploitation, percent change in commercial biomass, and the probability of biomass decline were determined from the model for a range of potential catches and are presented as catch scenario tables for subareas A–D in Tables 1–4. These catch scenarios for 2016 assume current year (2015) estimates of condition and use the mean of natural mortality estimates from the last five years (2011 to 2015) within each subarea. Note that for subarea A, biomass declines are predicted even if no catch is taken in 2016. This is partially due to the elevated natural mortality in the subarea (0.43 in 2015). Natural mortality in subarea A has been elevated (> 0.2) since 2011.

An example of how to interpret the catch scenarios in Tables 1–4 is presented using Table 2 for subarea B: a subarea catch of 15 t corresponds to an exploitation of 0.04 in the High habitat category and is projected to result in a 2.4% biomass increase in the High habitat category; the probability of biomass increase is 0.52. The model predicts an increase in biomass for all of subarea B of 8.1%; the associated probability of biomass increase is 0.59. For subareas B, C, and D in Tables 2–4, the probability of being above the lower reference point (LRP) is also presented.

Table 1. Catch scenario table for SFA 29 West subarea A to evaluate 2016 catch levels in terms of expected changes in biomass (%) and probability of increase.

Subarea Catch (t)	Exploitation in Medium Category	Expected Change in Biomass (%) in Medium Category	Prob. of Biomass Increase in Medium Category	Expected Change in Biomass (%) in Subarea	Prob. of Biomass Increase in Subarea
0	0.00	-12.5	0.41	-4.4	0.46
4	0.02	-14.6	0.40	-6.2	0.45
8	0.04	-15.4	0.39	-7.1	0.44
12	0.06	-16.4	0.38	-8.2	0.43
16	0.09	-16.2	0.37	-10.0	0.41
20	0.11	-19.7	0.35	-11.0	0.40
24	0.13	-21.2	0.35	-12.1	0.39
28	0.15	-22.3	0.34	-13.6	0.38
32	0.17	-24.6	0.32	-15.7	0.36
36	0.19	-25.8	0.31	-16.9	0.35

Table 2. Catch scenario table for SFA 29 West subarea B to evaluate 2016 catch levels in terms of expected changes in biomass (%), probability of increase, and probability of being above the LRP.

Subarea Catch (t)	Exploitation in High Category	Expected Change in Biomass (%) in High Category	Probability of Biomass Increase in High Category	Expected Change in Biomass (%) in Subarea	Probability of Biomass Increase in Subarea	Probability of Being Above the LRP
0	0.00	7.9	0.55	10.5	0.62	0.87
8	0.02	4.0	0.53	9.0	0.61	0.85
15	0.04	2.4	0.52	8.1	0.59	0.85
23	0.06	1.1	0.51	6.8	0.58	0.85
31	0.08	-1.5	0.49	6.1	0.57	0.85
39	0.10	-2.5	0.48	5.5	0.56	0.84
46	0.12	-5.0	0.47	4.4	0.55	0.83
54	0.14	-7.7	0.45	2.9	0.54	0.82
62	0.16	-10.4	0.42	2.1	0.53	0.81
70	0.18	-12.9	0.40	1.0	0.51	0.79

Table 3. Catch scenario table for SFA 29 West subarea C to evaluate 2016 catch levels in terms of expected changes in biomass (%), probability of increase, and probability of being above the LRP.

Subarea Catch (t)	Exploitation in High Category	Expected Change in Biomass (%) in High Category	Probability of Biomass Increase in High Category	Expected Change in Biomass (%) in Subarea	Probability of Biomass Increase in Subarea	Probability of Being Above the LRP
0	0.00	44.4	0.66	39.3	0.81	0.77
5	0.02	42.0	0.65	37.7	0.81	0.76
11	0.04	39.5	0.64	35.1	0.80	0.75
16	0.06	38.5	0.63	34.5	0.79	0.75
22	0.08	33.3	0.62	32.4	0.78	0.74
27	0.10	30.5	0.61	30.8	0.77	0.73
33	0.12	27.7	0.60	29.0	0.75	0.73
38	0.14	25.0	0.60	27.1	0.74	0.72
44	0.16	22.5	0.59	26.0	0.73	0.71
49	0.18	19.0	0.58	23.8	0.72	0.70

Table 4. Catch scenario table for SFA 29 West subarea 0 to evaluate 2016 catch levels in terms of expected changes in biomass (%), probability of increase, and probability of being above the LRP.

Subarea Catch (t)	Exploitation in High Category	Expected Change in Biomass (%) in High Category	Probability of Biomass Increase in High Category	Expected Change in Biomass (%) in Subarea	Probability of Biomass Increase in Subarea	Probability of Being Above the LRP
3	0.00	15.0	0.69	7.6	0.61	0.8
6	0.02	13.5	0.63	6.4	0.60	0.79
12	0.04	11.0	0.61	4.6	0.57	0.78
18	0.06	8.1	0.60	3.2	0.55	0.77
24	0.08	6.8	0.58	2.4	0.54	0.76
30	0.10	4.8	0.55	0.7	0.51	0.75
36	0.12	1.3	0.52	-0.7	0.49	0.74
41	0.14	-0.3	0.50	-2.0	0.48	0.73
47	0.16	-3.0	0.47	-3.8	0.44	0.71
53	0.18	-4.3	0.45	-4.8	0.42	0.70

For the precautionary approach, stock productivity for SFA 29 West is assessed in terms of biomass density in the High habitat suitability areas. Lower reference points for subareas B, C and D were established for the SFA 29 West fishery in the fall of 2015 and are 1.12 t/km^2, 1.41 t/km^2, and 1.3 t/km^2, respectively. More work is needed on subarea A as this area has very little of the High habitat suitability area that exists in the other subareas, which was the basis of the approach used. Unfortunately, no results are available for subarea E due to limited survey data and the lack of a habitat suitability map. In 2015, commercial biomass densities in subareas B, C, and D were above their respective LRPs (Figure 6). An upper stock reference (USR) has not been defined for this stock.

In subarea E, abundance of commercial sized scallop in 2015 remained relatively similar to 2014. Landings in 2015 (27.7 t) were also similar to 2014 (27.3 t) and commercial catch rates were relatively similar to 2014. However, abundance of recruits in 2015 are low and similar to values observed in 2014. Indications are that the population is stable at the current level of removals.

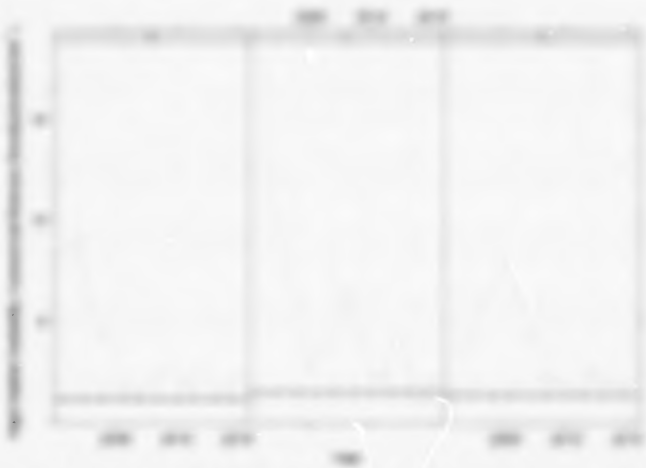

Figure 6. Commercial biomass densities (t/km^2) for the High habitat suitability category in SFA 29 West for subareas B, C, and D, with lower reference points indicated by the horizontal dashed line.

Ecosystem Considerations

Lobster Catch in the Fishery

In 2015, there were 530 observed trips (49 Bulk Fleet and 473 FB Fleet), 22 observed trips (4 Bulk Fleet and 18 FB Fleet) and 0 trips observed (1 Bulk Fleet and 0 FB Fleet). It was estimated that 6,891 lobsters were caught during the SFA 35 West scallop fishery in 2015 (Table 5). This corresponds to a weight of approximately 5.1 t using the average observed carapace length (88 mm) and average weight of a lobster (0.74 kg) caught in SFA 35 West in 2015. This weight is down from 2014 (8.7 t). The estimated number of lobster caught represents approximately 0.21% of the lobsters caught in the 2014/2015 Lobster Training Area (LFA) 35 lobster fishery and < 0.1% of the lobsters caught in the area of LFA 35 corresponding to SFA 35 West. In 2015, there was no fishing activity in subarea 4, so there are no lobster estimates for that area. Subarea 3 had the highest lobster bycatch estimate at 3,179 as opposed to subarea 6 in previous years.

Of the 5 trips completed in 2015, lobsters were measured and assessed for damage on only 3 of the trips. On the remaining trips, the lobsters were measured on 1 (no damage assessments) and only weighed on one (no measurements or damage assessments, because of this, there are limits to what can be inferred about estimates of lobster damage from the SFA 35 West fishery in 2015. As such, there are no damage estimates provided for the 2015 fishery. For the trip where lobsters were only weighed, the number of lobsters caught was estimated (assuming that 1 lobster = 1 kg. Trends in lobster catches by the lobster fishery in the SFA 35 West area as a whole are not indicative of an area that has been adversely affected by the scallop fishery since 2001.

Table 5. Estimated total numbers of lobsters caught in the scallop fishery (Full Bay and Fleet (Eastern Fleet) combined) for 2013–2015 based upon observer data. (CVs) refers to the percentage of trips or tows observed.

		Observed Data			Fishery	Estimated	
Year	Area	No. Lobsters	CV (%)	Weight (t)	Effort (h)	No. Lobsters	CV
2013	4	12	0	0.002	11	5,016	0.00
	5	251	49	7.9	97.1	1,994	0.49
	6	103	18	2.2	76.1	696	0.18
	3	43	27	0.3	45.6	636	0.63
	4	112	49	1.8	14.4	1,006	0.49
	Total	610		10.0	435.3	10,348	0.08
2014	4	0	0	0	0.0	0	0
	5	625	49	7.1	100.9	2,005	1.00
	6	0	0	0	5	0	0
	3	0	0	0	0	0	0
	4	37	49	1.2	27.3	1,006	0.51
	Total	662		8.3	133.2	3,011	0.78
2015	4	0	0	0	0	0	0
	5	116	0	0.7	16.1	706	0
	6	39	0	0.3	14.7	694	0
	3	87	0	1.0	24.8	3,179	0
	4	42	0	1.0	27.3	906	0
	Total	274		2.9	83.0	5,487	0

* no damage estimates provided for the 2015 fishery due to incomplete sampling during trips or low observer coverage

Other Catch in the Fishery

The discard rates of all species in the 2016 scallop fishery (Table 6) were within ranges of discards observed in previous years.

Table 6. Inshore scallop discard rate for landed species in 2016 (Maine) by year from 2010. Discard rate are the weight of discards (kg) divided by the weight of landings (kg). Model number having the observed data. Only species that were caught in 2016 are shown. For previous years' data, see Newsletter at sp. 2011.

Species	Rate	Species	Rate	Species	Rate
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
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Acknowledgements

In 2016, commercial licensees (penalties in subsection B, C, and D were above their respective LRPs). Indications for subsection D are that this population is stable at the current levels of removals. For subsection E, minimum electrode size prohibited levels of no catch in others in 2016.

Contributions

Name	Affiliation
[illegible]	[illegible]
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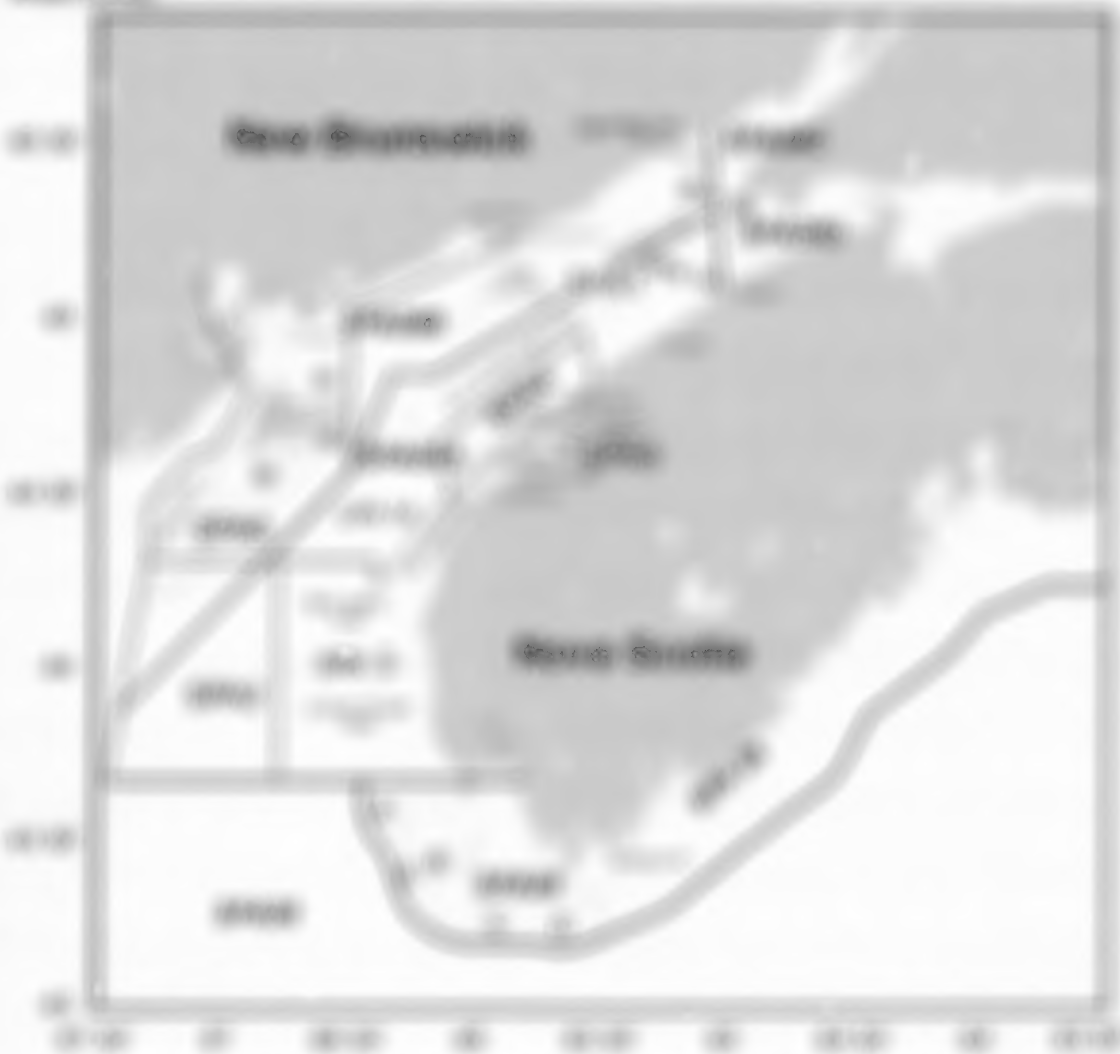

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